ESCI 461: Seismology

Instructors: Fenglin Niu
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Office hours: 2:00-4:00 pm Tuesday

Room: 327

Time: 11:00-11:50 MWF

Text: "Introduction to Seismology" Second Edition
by Peter Shearer

Grading:

Participation	20%
Assignments	40%
Final exam	40%

Syllabus:

1. Introduction
    a. History of seismology

2. Math review
    a. Vector calculus
    b. Complex numbers

3. Stress and strain
    a. Stress and strain tensors
    b. Linear stress-strain relationship, elastic tensor, elastic moduli

4. Seismic wave equation
    a. Momentum equation
    b. Elastic wave equation
    c. Potentials
    d. Plane and spherical waves
    e. P- and S-waves

5. Ray theory
    a. Eikonal equation
    b. Snell's law
    c. Rays paths (flat and spherical Earth)
    d. Traveltime curves and delay times
    e. Seismic phases and nomenclature
    f. Seismic wave energy, geometrical spreading

g. Reflection and transmission coefficients
h. Attenuation

6. Seismometry
    a. Inertial Pendulum System
    b. Mathematical representation of the response
    c. Force-balance accelerometers and seismometers
    d. Broadband seismometers
    e. Earth's noise

7. Surface waves and normal modes
    a. Introduction
    b. Rayleigh waves in a homogeneous halfspace
    c. Love waves in a layer over halfspace
    d. Surface waves on the spherical Earth
    e. Dispersion
    f. Surface wave tomography
    g. Normal modes of a string
    h. Normal modes of the Earth
        i. Toroidal
        ii. Spherical modes
    i. Normal modes observations

8. Earthquakes
    a. As a source of elastic waves
        i. Locating earthquakes
        ii. Determining focal mechanism of an earthquake (Double couple, Moment tensor)
        iii. Source time function
        iv. Source spectra
        v. Far-field pulse shape
    b. As a rupture process
        i. Stress drop
        ii. Rupture velocity
    c. Magnitudes, Intensity and Moment
    d. Earthquakes statistics
    e. Seismicity and Plate tectonics
    f. Earthquake cycles and earthquake prediction